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Mr. Edward F. Mussler, III, P.E.
NCDENR
1646 Mail Service Center
Raleigh, NC 27699-1646



**Re: East Carolina Regional Landfill
Construction of Cell No. 12
Bertie County, North Carolina
Permit No. 08-03
HHNT Project No. 6703-273-01**

Dear Mr. Mussler:

We have enclosed a response from Bunnell-Lammons Engineering, Inc. to your e-mail comments on the subject project CQA Report.

Should you have any questions, please call.

Sincerely,

HODGES, HARBIN, NEWBERRY & TRIBBLE, INC.

William F. Hodges, P.E.
Professional Engineer

WFH/rm

Enclosure

cc: Ray Hoffman, P.E., w/encl.
Mitch Hoggard, w/encl.
Dan Bunnell, P.E., w/o encl.
Matt Cheek, P.E., w/o encl.

PROJECT MEMO

**EAST CAROLINA REGIONAL MSW LANDFILL
CONSTRUCTION OF CELLS NO. 12
BERTIE COUNTY, NORTH CAROLINA**

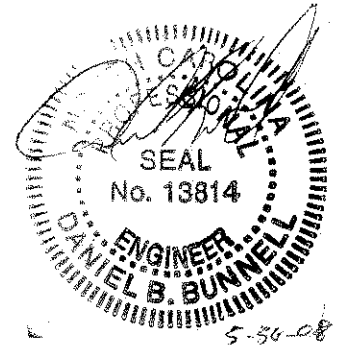
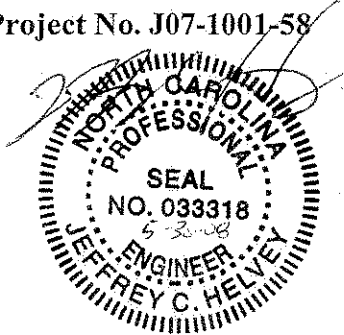
BLE Project No. J07-1001-58

To: Mr. Bill Hodges, P.E.

From: Mr. Dan Bunnell, P.E.
Mr. Jeff Helvey, P.E.

Date: May 29, 2008

Subject: Reply to Technical Review of CQA Report – Cell 12 Construction
(Phase 4) by North Carolina DENR Dated May 28, 2008



The purpose of this letter is to provide comments and clarifications to the document titled "Technical Review of CQA Report – Cell 12 Construction (Phase 4), East Carolina Regional MSW Landfill, Bertie County, North Carolina" dated May 28, 2008 prepared by Ming-Tai Chao of the NC DENR. The original NCDENR document is amended with our responses to each item. Our response comments are in *bold italic* type.

Technical Review of CQA Report – Cell 12 Construction (Phase 4)

East Carolina Regional MSW Landfill

Bertie County, North Carolina

Permit No. 08-03

Starting Date: 05/15/2008

Reviewed by: Ming-Tai Chao

Completion Date: 05/28/2008

General

Comment 1 (Table of Content): The page numbers of the subjects are not consistent with the ones in the report. Please make necessary correction.

Response: These edits have been made to the CQA report and the corrected page is attached.

Section 3.1.4.3

- 1) Comment 2 (page 8): According to the test results in Appendix D, the results of permeability of soil samples collected from the test pad are ranging from 1.9E-08 cm/s to 4.6E-08 cm/s, not 1.9E-08 cm/s to 5.1E-08 cm/s. Please clarify.

Response: The reviewer was referencing the summary table for the Bulk Sample & Stockpile Testing report for Remolded Permeability Samples. The results reported for the test pad undisturbed permeability samples range from 2.0×10^{-8} cm/s (lowest/slowest value) to 5.1×10^{-8} cm/s (highest/fastest value) as noted in the table titled Summary of Clay Liner Hydraulic Conductivity Testing. The typographical edit (2.0 rather than 1.9×10^{-8} cm/s) has been made to the CQA report and the revised report page is attached.

Section 3.1.4.4

Comment 3: Several soil samples were failed to meet the field density requirements and noted in Appendix E (see Comment 15); therefore, it is imperative to discuss in this Section how these grid areas (approximately 100-ft by 100-ft) were re-compacted and re-worked to achieve the compaction effort and density objective. Please revise this Section accordingly.

Response: As noted in the report text, all areas which initially failed to meet the compaction criteria were recompacted using sheepsfoot and smooth drum rollers and ultimately met or exceeded the project requirements. A summary of the initially failing and ultimately passing density tests is provided in the Appendix E. In order to provide more clarity for the reviewer, this additional information has been included in the CQA report and the added page provided. Density test results are uniformly reported to the nearest whole percent using proper rounding procedures.

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Bertie County, North Carolina

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Section 3.1.5

- 2) Comment 4 (page 10, the fourth paragraph): The pre-deployment meeting minutes are presented in Appendix B, and not in Appendix G. Please correct this typo.

Response: This typographical edit has been made to the CQA report and the revised report page is attached.

Section 3.1.6

Comment 5 (page 13): There are discrepancies of (1) the number of samples of washed sand

Response: The text indicates that conformance testing included 5 grain size (ASTM D 422) and 3 hydraulic conductivity (permeability) tests (ASTM D 2434). In order to provide more clarity for the reviewer, we have changed the word “included” to “required”. This edit has been made to the CQA report and the revised report page is attached.

While only 5 grain size and 3 permeability tests were required, a total of 8 grain size and 9 permeability tests were performed, exceeding the project requirements.

[Comment 5 continued] and (2) data ranges of permeability values of native sand between Appendix D and this Section. Please clarify.

Response: The results reported for the native sand permeability samples range from 2.1×10^{-3} cm/s (lowest/slowest value) to 1.5×10^{-2} cm/s (highest/fastest value) and are correctly stated in the report text and summary table. No change is required.

Comment 6: The quantities of washed sand and native sandy soil used for constructing protective cover need be provided in the CQA report, so that whether or not the corrected number of CQA tests performed, in accordance with the Specification, can be confirmed.

Response: The quantity of native sand was stated on the testing summary table. The requested additions have been made to the CQA report text and the revised report page is attached.

Appendix A

Comment 7 (Figure 3 - Subgrade As-Built Survey): The subgrade slopes, drain transverse (north/south direction) flow to trunk line (east/west direction), on the as-

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built figure were spot checked, and slope values of less than two (2) percent [refer to Rule .16249b)(7)] were found. Please clarify.

Response: *The as-built survey for the clay liner subgrade indicates all elevations are at or below design subgrade elevations, as desired. Slopes of the clay liner subgrade are not critical and therefore are not specified, but they do reflect the clay liner surface grades and slope to the leachate pipe locations at approximately 2%.*

Comment 8 (Figure 3 – Compacted Clay Liner (CCL) As-Built Survey): The base slopes of CCL on the as-built figure (several less than 2 percent in north/south direction) were less than those on the Sheet 3 of 8 in the “Specification and Construction Documents (the Specification).” Please clarify.

Response: *Drainage occurs along a path perpendicular to the maximum slope and not in a north/south direction. The minimum base slopes along the drainage path indicated on the top of clay as-built survey was measured to be greater than or equal to the required 2%.*

Comment 9 (Figure 3 – Protective Cover As-Built Survey): The slope of the in-place HDPE leachate piping - L4 is 1.23% which is less than the designed value of 1.4% as shown on the Sheet 4 of 8 in the “Specification.” Please clarify. Additionally, the elevation data of the protective cover at a point (on the west side, near edge of the cell, and upgradient point of the first transverse rib line) is missing. Please provide the survey data.

Response: *Leachate line L-4 lies on a layer of cushion geotextile which overlies the geomembrane. The grades in this area, therefore, follow the top of clay liner and not the grades for the top of protective cover / leachate collection system shown on the Protective Cover As-built. The project documents Sheet 4 of 8 dated September 2007 and revised November 20, 2007, indicate the minimum design grade for leachate pipe L4 is 0.7% (not 1.4%). The as built grade for L-4 is 0.8%.*

The missing data point noted by the reviewer is in the temporary storm water drainage channel at a rain flap location. Protective cover will not be placed here until the associated subcell is put into service.

Comment 10 (Figure 3 – FML As-Built Survey): The following sample locations can not be found on the as-built figure, please add these location to the figure.

- 3) The destructive sample location, Ds-67 and repair sample location, R519 at the intersection of panels C-11 and S-88.

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Response: *Repair 519 and DS-67 are in the same location and have been added to the FML as-built. A revised copy of the FML as-built is attached.*

Appendix D

Comment 11: The hydraulic conductivity (K) of sample LP-1-9 is $1.3\text{E-}07$ cm/sec, under confine pressure 75 psi, which is fail to meet the required $K=1.0\text{E-}07$ cm/sec. The second test on sample LP-1-9A has $K=2.9\text{E-}08$ which is passing the hydraulic conductivity criterion for compacted clay liner; however, the confine pressure exerted on the second sample LP-1-9A was increased to 85 psi. Please explain:

- 1) What is the logical reason to increase the confine pressure to 85 psi from 75 psi (the constant confine pressure was used on most samples)? If the estimated overburden pressure determines selection of a confining pressure for a sample, the higher pressure shall be reasonable selected for the samples in the first lift. However, the different confining pressures (85 or 75 psi) were likely randomly applied on samples located in different grids and lifts throughout the testing. Please clarify.

Response: *“Confining Pressure” should not be confused with “Effective Confining Pressure” / “Effective Stress”. The Effective Stress on both samples was 15 psi as desired. The effective stress is equal to the “confining pressure” minus the “influent pressure” (pore pressure). The noted variations of the confining pressure are used to aid in saturation of the sample and have no influence on sample consolidation and do not result in varying permeability test results for the same material.*

- 2) Why did the procedures to handle the fail testing result stated in **the Specification** (page 7, Item G. h. of II. Compacted Clay Liner) not implemented at that time?

Response: *Damage to the LP-1-9 sample occurred during set-up in the laboratory – a laboratory error. The test sample was replaced with sample LP-1-9A obtained 6 inches from the damaged sample. LP-1-9A represents the in-place clay, meets the project permeability criteria and has been designated sample LP-1-9 to replace the damaged sample.*

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Comment 12: There are discrepancies of sample IDs and sample locations of LP-1-1, LP-2-1, LP-3-1, & LP-4-1 (refer to Pages 43 of 138, 60 of 138, 76 of 138, and 90 of 138) of Test Reports in Appendix D and summary tables in Appendices D and J. Please clarify.

Response: *Sample ID's "LP" for the test pad samples should have been identified as "TPLP". The text and tables have been revised to show the undisturbed permeability test pad samples identified as "TPLP" in all locations. The revised report pages are attached. There are no discrepancies between summary table test locations.*

Appendix E

Comment 13: The discrepancies of grid numbers were found in Tables as shown below:

Test No./Table	Table - Field Density Grid Map Checklist	Table - Field Density Test Results for Drive Tube
CLD-39	GRID 37	GRID 57
CLD-171	GRID 60	GRID 66
CLD-181	GRID 6	GRID 3
CLD-218	GRID 62	GRID 46

Please clarify.

Response: *The "Table – Field Density Grid Map Checklist" correctly shows the grid numbers. The "Table – Field Density Test Results for Drive Tube [and/or Nuclear Gauge]" has been corrected. These typographical edits have been made to the CQA report and the revised report page is attached.*

Comment 14: Typo on page 118 of 123. Test No CLD-225 [~~CLD-255~~] was at the same location of LP-3-15, not L-3-15. Please make necessary correction.

Response: *L-3-5 was corrected to be LP-3-5. This typographical edit has been made to the CQA report and the revised report page is attached.*

Comment 15: The samples that were collected from CCL and failed the field density test are listed below:

Sample	Dry Density (pcf)	95% Max. Dry Density (pcf)
CLD-33	100.3	100.415
CLD-95	100.2	100.415
CLD-112	100.2	100.415
CLD-118	100.2	100.415
CLD-119	100.4	100.415

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CLD-120	100.3	100.415
CLD-122	100.2	100.415
CLD-123	100.2	100.415
CLD-183	100.2	100.415
CLD-199	99.7	100.415
CLD-204	97.6	100.415
CLD-209	98.5	100.415
CLD-234	100.2	100.415

According to Item G of Part 3 of the Specification Section 02250 –Compacted Clay Liner (CCL), CCL density that is less than 95 percent of the maximum dry density determined from the Standard Proctor test shall be re-compacted and/or removed and reworked to meet density objectives. However, above-referenced soil samples that were field tested by a nuclear gauge having dry density results less than 95 percent of the maximum dry density; but no further actions were addressed or taken (no re-testing results are available, and no description of how the unacceptable CCLs were handled in the field [refer to Section II. G. h of CQA manual]). Please clarify.

Response: *As noted in the reviewer's comments, the project documents require "95%" compaction. All density tests were reported to the nearest whole percent using proper rounding procedures. Use of more significant figures is not warranted. CLD-33, 95, 112, 118, 119, 120, 122, 123, 183, and 234 therefore, meet the required 95% compaction. As noted in the test results, CLD-199, 204, and 209 meet the required 95% compaction; however, a typographical error references the incorrect standard Proctor maximum dry density. These typographical edits have been made to the CQA report and the revised report pages are attached.*

Comment 16: Typographic errors. Some subgrade samples are passing the field density criterion but noted as "F" for failing test; they are SFD-81, SFD-83, SFD-85, SFD-86, & SDF-141. However, one sample SFD-142 did fail the density but no further action and re-test were reported in the CQA report. Please clarify.

Response: *These tests indicate that the tested soils meet the project percent density compaction criterion. However, these soils failed to meet moisture content criterion established by the engineer for these particular soils (too wet). As a result, the soils were allowed to dry and were retested after additional compactive effort was applied. In order to provide more clarity for the reviewer, this additional information has been included in Summary of Field Density Retests, Structural Fill, and is attached.*

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Appendix G

Comment 17: In the Panel Identification and Placement (sheet 2 of 3, dated 3/13/2008) the number of “cumulative panel area of 90,363 square feet is incorrect, which shall be 90,318 ft². This mistake was carried over the rest of sheets. Please make corrections.

Response: These typographical edits have been made to the CQA report and the revised corresponding pages are attached.

Comment 18: The Panel Identification and Placement for the date 3/22/2008 was an incomplete one, without providing data of each panel length and area. Please make necessary revision.

Response: These typographical edits have been made to the CQA report and the revised corresponding pages are attached.

Comment 19: The Specification Part 2.03 in Section 02745-5 required gate valves (ASAHI Type O or equal) to be used in the leachate piping system. No manufacturer/contractor submittal of the gate valve is available in Appendix G. Please clarify.

Response: No gate valves were used in the construction of Cell No. 12. The gate valve noted for Leachate Manhole No. 11 was installed as part of Cell No. 11 construction.

Comment 20: The manufacturer’s 20-yr warranty for FML (refer to Section 02750-3) is not included in Appendix G. Please provide the warranty document.

Response: This additional information will be provided.

Comment 21: Two panels on the south side of FML panels S-21 & S-22 did not assigned identifications, and no documentations of test seam or field seam data associated with two panels. The similar situation was observed on the north side of panel S-33. Please clarify.

Response: No additional panels exist. The lines shown on the FML as-built drawing are repairs that cross these panels (S-21 and S-22,) as noted in the repair log.

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Comment 22: In Table 5- Panel Repair, the repair sample ID at the intersection of panels S-66 & S-68 for destructive sample No. DS-63 shall be R232, not R-234. Please make necessary correction.

Response: *Table 6 (QC Destructive Sample Testing) was corrected to match Table 7 (CQA Destructive Sample Testing), Table 5, and the FML as-built. This typographical edit has been made to the CQA report and the revised corresponding page is attached.*

Comment 23: Discrepancies were found between Table 7- QA Destructive Seam Strength Testing and as-built figure (Figure 3 - FML As-Built Survey); which are described below:

Sample	Panels shown in Table 7	Panels shown on as-built figure
DS-8	P18/P12	S-18/S-17
DS-20	P34/P35	S-34/S-36
DS-39	P44/P45	S-44/T-45
DS-65	T86/T87	T-86/T-91

Additionally, throughout the report, the panel IDs were assigned in the nomenclature either S-XX or T-XX. For the sake of consistency, please change all panel IDS from P-XX to S-XX in Table 7.

Response: *These typographical edits have been made to the CQA report and Table 7 revised as noted. The corresponding revised report pages are attached.*

Appendix J (CQA Summary Tables)

Comment 24: There are discrepancy of values (see Table below) of maximum dry density and optimum water content for sample SF-3-C11 in Table of “Summary of Protectors – Structural Fill (Appendices B & J)” and in Table of “Field Density Test Result for Drive Tube (Appendix E).” Please clarify.

Summary of Protectors – Structural Fill (Appendices B & J)	
Maximum dry density (pcf)	Optimum water content (%)
107.3	17.8
Field Density Test Result for Drive Tube (Appendix E)	
Maximum dry density (pcf)	Optimum water content (%)
111.5	11.1

Response: *Proctor Number SF-3-C11 (107.3 pcf MDD and 17.8% OMC) was not used. SF-4-C11 was used (111.5 pcf MDD and 11.1% OMC) and is consistent with the MDD and OMC referenced in the testing*

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*documentation. The reference to SF-3-C11 was a typographical error.
The corresponding revised report pages are attached.*

Comment 25: Typos –

(Table of “Summary of Design and Operation Plan - Smooth HDPE
Geomembrane Test frequency Requirements”)

- The total weight of geomembrane, according to Poly-Flex material pr-certification list, is 181,296 pounds, not 177,772 pounds.

Response: *The total weight for the geomembrane reported by Poly-Flex is the total weight of the geomembrane including the roll core. The roll core is not part of the geomembrane and, therefore, was not used to calculate the geomembrane weight and the corresponding number of required tests. This weight is included by Poly-Flex for shipping/trucking restrictions and not for MQC purposes. The total weight reported by BLE is calculated by multiplying the average thickness of the roll by the width and length to determine a volume. The reported sheet density is then used to calculate the weight of the geomembrane manufactured for MQC test frequency purposes. Regardless, the variation does not alter the required number of MQC tests.*

- Testing method for thickness of smooth FML shall be ASTM D5199, not D5994.

Response: *These typographical edits have been made to the CQA report and the revised report pages are attached.*

- The number of CQC test of NCTL is 12, not 1.

Response: *The results of 12 tests were reported by the manufacturer but only one 1 was required. This typographical edit has been made to the CQA report and the revised report page is attached.*

(Table of “Summary of CQA Conformance Test Results HDPE
Geomembrane”)

- Testing method for thickness of smooth FML shall be ASTM D5199, not D5994.

Response: *These typographical edits have been made to the CQA report and the revised report pages are attached.*

(Table of “Summary of CQA Conformance Test Results HDPE
Geomembrane”)

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- Tensile strength of the sample HS2-6-07-6092-5 is 180 ppi at yield, not 190 ppi.

Response: *This typographical edit has been made to the CQA report and the revised report page is attached.*

- Sheet densities of the samples HS2-6-07-6112-5 and HS2-6-07-6116-5 are 0.948 g/cc, not 0.947 g/cc.

Response: *These typographical edits have been made to the CQA report and the revised report pages are attached.*



REPORT TEXT
REVISED PAGES

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Based on a review of the permeability test of the remolded samples obtained from exploration of the Tripp Property borrow area as well as our experience on the site, a minimum density of 95% of the standard Proctor (ASTM D 698) maximum dry density, at a moisture content of 2% or more wetter than the Standard Proctor optimum moisture content, was selected for compaction of the test pad.

Following processing and compaction of each lift of the test pad, in-place density tests were performed using the nuclear method (ASTM D 2922). A bulk sample of the soil from each lift was obtained for laboratory Proctor compaction testing (ASTM D 698). Undisturbed Shelby tube type samples were obtained from each of the four lifts for laboratory permeability testing.

Laboratory hydraulic conductivity (permeability) tests (ASTM D 5084) were performed on the undisturbed samples obtained from the test pad. Test results ranged from $k = 2.0 \times 10^{-8}$ to 5.1×10^{-8} cm/s. The performance of the test pad confirmed the preliminary compaction moisture-density criteria.

In summary, the selected clay liner borrow soil from the Tripp Property borrow area was found to be acceptable for construction of the compacted clay liner at the target criteria. Following successful performance of the test pad, the clay liner test pad soils were incorporated into the completed compacted clay liner.

3.1.4.4 Clay Liner Construction

R. B. Baker placed four nominal 6-inch thick (compacted) lifts of the selected Layer I soils from the Tripp Property borrow area as the compacted clay liner to achieve the required minimum 24 inch clay liner thickness and top of clay elevations for Cell No. 12. Placement of the compacted clay liner was conducted in accordance with the project specifications and the Construction Quality Assurance Manual and the results of the test pad. Photographs of the compacted clay liner in Cell No. 12 are included in Appendix C. A Clay Liner As-built Drawing is presented in Appendix A.

The CQA field personnel monitored the borrow soil excavation and identified soils acceptable for use consistent with the earlier borrow study and test pad construction. The material was initially spread by bulldozers, processed with a disc harrow and compacted by a CAT 815 sheepsfoot compactor. The surface of the clay was compacted and sealed using a vibratory smooth drum roller at the end of each day and prior to rain events to protect the layer from wetting, erosion, and desiccation. Lifts No 1, 2 and 3 were scarified prior to placement of the overlying lift. Lift No. 4 was completed by smooth rolling prior to installing the geomembrane.

In accordance with the CQA Manual and project specifications, seven samples of the 60-mil HDPE geomembrane (number of samples equal to cube root of total number of textured and total number of nontextured rolls) were tested for laboratory materials CQA conformance testing. Sheet Density (ASTM D 1505), Melt Index (ASTM D 1238), Carbon Black Content (ASTM D 1603), Tensile Properties (ASTM D 638, GRI GM-13) and, Tear Resistance (ASTM D 1004, Die C) tests were performed. Each roll manufactured for Cell No. 12 was sampled and tested for thickness (ASTM D 5994 (textured) and ASTM D 5199 (nontextured)). The laboratory results for the test properties indicated that all of the 62 rolls of textured and nontextured 60-mil geomembrane meet the project requirements.

In addition to the original 62 rolls of liner manufactured for the project, 2 rolls of the Poly-Flex geomembrane manufactured for another, concurrent Republic Services of North Carolina project were shipped to the East Carolina project for use in the installation of the geomembrane liner. Additionally, one roll of Agru America textured geomembrane remaining on site from a previous Republic Services of North Carolina project was used in the base liner. These three rolls were sampled and tested as part of the Republic Services of North Carolina projects in accordance with the East Carolina Cell No. 12 project requirements. The three additional rolls of textured geomembrane meet the East Carolina Cell No. 12 project requirements.

Following review of the CQA and CQC test results, the 19 rolls of textured and 46 rolls of nontextured geomembrane were approved for use for Cell No. 12.

Installation of the geomembrane for Cell No. 12 began on March 10, 2008 and was completed on March 23, 2008. Construction quality assurance monitoring and testing were performed by BLE on a full-time basis. A pre-deployment meeting was conducted by the BLE project engineer, Mr. Jeff Helvey, P.E., prior to the beginning of geomembrane deployment. The pre-deployment meeting minutes are presented in Appendix B. Records of daily observations made by the CQA personnel during deployment and testing are presented in Appendix B. Photographs of the installation are presented in Appendix C.

American Environmental Group (AEG) installed the geomembrane. The surface of the clay liner was maintained with moisture application and smooth drum rolling by R. B. Baker. The finish surface was inspected and approved for geomembrane placement by BLE and AEG. AEG welded, sampled, patched, tested, and repaired the geomembrane. The panels of geomembrane were seamed using hot wedge double-track fusion welding. Fillet extrusion welding was used on seams not suited for hot wedge double-track fusion welding and to seam repair patches.



from the borrow area to the cell. Additional samples of the protective cover borrow sand were obtained from the borrow area during excavation and hauling to the cell for laboratory CQA conformance testing. The laboratory testing frequency of one permeability test per 3,000 cubic yards of protective cover sand was performed, as required by the project CQA Manual (42,100 cy, in place). The laboratory testing for the on site sand included 15 hydraulic conductivity (permeability) tests (ASTM D 2434). The permeability (k) values of the onsite sand used for the cell ranged from 2.1×10^{-3} cm/s to 1.5×10^{-2} cm/s, which met the specified permeability criteria of $k \geq 1 \times 10^{-3}$ cm/s.

The washed sand protective cover was obtained from the nearby River Bend Sand Pit. The washed sand protective cover stockpile at the sand pit was sampled and tested as part of the required stockpile testing prior to being hauled to the site. Samples of the washed sand were selected for laboratory grain size and permeability testing. The CQA personnel monitored the delivery of the sand to the landfill. Additional samples of the washed sand protective cover were obtained from the on-site stockpile during hauling to the landfill for laboratory CQA conformance testing. The laboratory testing frequency of one grain size test per 1,500 cy and one permeability test per 3,000 cubic yards of protective cover sand were performed, as required by the project CQA Manual (6,100 cy, in place). The laboratory testing for the washed sand required 5 grain size (ASTM D 422) and 3 hydraulic conductivity (permeability) tests (ASTM D 2434). The permeability (k) values of the washed sand used for the cell ranged from 2.5×10^{-2} cm/s to 5.6×10^{-2} cm/s, which met the specified permeability criteria of $k \geq 1 \times 10^{-2}$ cm/s.

The laboratory test results and a summary of permeability test results are presented in Appendix D of this report. The sands were classified as a light brown to yellow slightly silty to silty fine to medium sand. The sands were relatively free of nodules, refuse, roots, and other deleterious substances. In summary, the sand was found to be consistent in gradation, free of oversized rock, debris, or excessive fines, and was acceptable for use in the cell.

The leachate drainage stone materials (ASTM No. 57 & NC DOT No. 78M) were furnished by Wake Stone – Nash County Quarry. Gradations of both materials are presented in Appendix H. The materials meet the project requirements and were acceptable for use in the cell.

Product Certifications for the HDPE leachate collection pipe and the 6 and 24 osy nonwoven geotextiles used in the cell are included in Appendix H. The CQC laboratory testing and certifications provided for our review indicate values within the accepted range and are included in Appendix H. The materials were found to meet the project requirements and were accepted for use.

The protective cover sand placement began on March 24, 2008. The sand used to cover the cell floor was hauled by truck from the on-site borrow area to the cell on minimum 4 foot thick haul roads within the cell limits. The sand was spread across the cell using a CAT D6 low-ground-pressure bulldozer. During protective cover placement, the minimum 6-oz nonwoven geotextile and the geomembrane were monitored by the CQA technician for excessive slack, folds, and/or trampolining throughout the workday as it was covered. No distress to the geotextile or the underlying geomembrane was observed.

An as-built survey of the protective cover sand, prepared by Wright and Fields Land Surveying, Inc., is presented in Appendix A. A review of this as-built survey, as well as random depth checks and our full time construction monitoring, conclude that a minimum thickness of 2 feet of protective cover was placed everywhere within Cell No. 12.

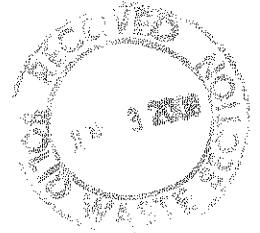
Based on our full-time construction monitoring, performance of the CQA testing, the provided as-built survey information, and our review of the provided product certifications, the Cell No. 12 protective cover and leachate collection system components and construction were found to be in conformance with the Project Plans and Specifications and the CQA Manual.

In conclusion, the Cell No. 12 construction activities consisting of the:

- Structural fill placement
- Proofrolling and subgrade preparation
- Clay liner borrow evaluation
- Test pad construction
- Compacted clay liner placement
- Geomembrane (Flexible Membrane Liner, FML) installation
- Protective cover layer and leachate collection system construction

were completed in accordance with:

- The Construction Plans and Technical Specifications
- The CQA Manual
- The Permit
- Requirements of NC DENR
- Acceptable engineering practices



APPENDIX A

REVISED FML AS-BUILT SURVEY

The Revised figures are including in the
final approved CQA report.



APPENDIX J

CQA SUMMARY TABLES

(REPLACE ENTIRE APPENDIX)

**SUMMARY OF PROCTORS - STRUCTURAL FILL
CONSTRUCTION OF CELL NO. 12**

**CONSTRUCTION QUALITY ASSURANCE
EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1001-58**

SAMPLE DESIGNATION	STANDARD PROCTOR PARAMETERS (ASTM D 698)	
	MAXIMUM DRY DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
SF-1-C11	114.5	14.5
SF-2-C11	108.7	17.3
SF-4-C11	111.5	11.1
P-4-4	104.9	19.5
TP-5-C9	99.2	21.5
CLSP-2-C12	105.7	18.0

**SUMMARY OF PROCTORS - COMPACTED CLAY LINER
CONSTRUCTION OF CELL NO. 12**

**CONSTRUCTION QUALITY ASSURANCE
EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
Bunnell-Lammons Engineering, Inc. Project No. J07-1001-58**

SAMPLE DESIGNATION	STANDARD PROCTOR PARAMETERS (ASTM D 698)	
	MAXIMUM DRY DENSITY (PCF)	OPTIMUM MOISTURE CONTENT (%)
TP-5	100.1	19.9
CLSP-2-C12	105.7	18.0
CLSP-3-C12	102.6	20.4

SUMMARY OF CQA CONFORMANCE TESTING - COMPACTED CLAY LINER CONSTRUCTION OF CELL NO. 12

CONSTRUCTION QUALITY ASSURANCE
EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA

Bunnell-Lammons Engineering, Inc. Project No. J07-1001-59

Cell No. 12 = 651,000 sq ft (15 Acres) = 48,177 cy Clay Liner

TEST METHOD	REQUIRED FREQUENCY	REQUIRED NUMBER OF TESTS	NUMBER OF TESTS PERFORMED*
FIELD TEST			
DENSITY	ASTM D 2922 or D 2937	272	272
MATERIAL GRAIN SIZE	< 3-INCH SIEVE FOR LOWER 18 INCHES (100% avg) < 1-INCH SIEVE FOR UPPER 6 INCHES (95% avg all tests & 100% avg 3-INCH SIEVE)	136	136
LABORATORY TEST			
CLAY LINER STOCKPILE SAMPLES (BEFORE PLACEMENT)			
MOISTURE-DENSITY (PROCTOR)	ASTM D 698	5	5
REMOLED PERMEABILITY	ASTM D 5084	5	5
GRAIN SIZE	ASTM D 422	1	1
MOISTURE CONTENT	ASTM D 2216	1	1
ATTERBERG LIMITS	ASTM D 4318	1	1
UNDISTURBED SAMPLES (DURING PLACEMENT):			
PERMEABILITY	ASTM D 5084	64	64
DRY DENSITY	ASTM D 2922	64	64
MOISTURE CONTENT	ASTM D 2216	64	64
BULK SAMPLES (DURING PLACEMENT):			
MOISTURE-DENSITY (PROCTOR)	ASTM D 698	8	8
GRAIN SIZE	ASTM D 422	8	8
MOISTURE CONTENT	ASTM D 2216	8	8
ATTERBERG LIMITS	ASTM D 4318	8	8

**SUMMARY OF CQA BORROW AND BULK SAMPLE CONFORMANCE TESTING - COMPACTED CLAY LINER
CONSTRUCTION OF CELL NO. 12**

CONSTRUCTION QUALITY ASSURANCE
EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA

Bumell-Lammons Engineering, Inc. Project No. J07-1001-58

Cell No. 12 = 651,000 sq ft (15 Acres) = 48,177 cy Clay Liner

	MATERIAL DESCRIPTION	PERCENT FINES (#200 sieve)	ATTERBERG LIMITS		PROCTOR PARAMETERS		REMOLD PARAMETERS		REMOLDED HYDRAULIC CONDUCTIVITY (PERMEABILITY) cm/s
			LIQUID LIMIT %	PLASTICITY INDEX %	MAXIMUM DRY DENSITY pcf	OPTIMUM MOISTURE CONTENT %	DRY DENSITY (% COMP.) %	MOISTURE CONTENT (% WET OF OPT.) %	
CLSP-1-C12	Light Brown & Grey fi Sandy CLAY	89.8	40.0	21.0	106.3	17.9	101.0 (95)	24.1 (6.2)	2.2E-08
CLSP-2-C12	Light Brown & Grey fi Sandy CLAY	—	—	—	105.7	18.0	101.0 (96)	23.0 (5.0)	2.7E-08
CLSP-3-C12	Light Brown & Grey fi Sandy CLAY	—	—	—	102.6	20.4	97.4 (95)	26.1 (5.7)	3.6E-08
CLSP-4-C12	Light Brown & Grey fi Sandy CLAY	—	—	—	103.8	19.0	99.1 (96)	25.0 (6.0)	5.0E-08
CLSP-5-C12	Grey & brown fi-med. Sandy CLAY	—	—	—	105.6	17.1	101.0 (96)	24.0 (6.9)	4.8E-08
LTP-1-1	Light Brown & Grey fi Sandy CLAY	80.8	43	23	110.9	16.2	106 (96)	20 (3.8)	1.9E-08
L-1-2	Light Brown & Grey fi Sandy CLAY	87.0	42	24	103.6	18.8	—	—	—
LTP-2-1	Light Brown & Grey fi Sandy CLAY	71.4	41	25	108.0	18.0	103.1 (96)	22.0 (4.0)	1.6E-08
L-2-2	Light Brown & Grey fi Sandy CLAY	73.4	43	26	106.2	17.1	—	—	—
LTP-3-1	Light Brown & Grey fi Sandy CLAY	75.9	44	26	104.4	14.3	100.0 (96)	22.0 (7.7)	4.1E-08
L-3-2	Light Brown & Grey fi Sandy CLAY	82.8	45	27	104.6	18.5	—	—	—
LTP-4-1	Light Brown & Grey fi Sandy CLAY	77.3	42	24	106.8	16.5	102.1 (96)	23 (6.5)	4.6E-08
L-4-2	Light Brown & Grey fi Sandy CLAY	87.3	45	27	108.0	14.9	—	—	—

SUMMARY OF CLAY LINER HYDRAULIC CONDUCTIVITY TESTING

CONSTRUCTION OF CELL NO. 12
EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
BLE Project No. 107-1001-58

Cell No. 12 area = 667,000 sq ft (15.3 Acres) = 48,177 cy Clay Liner

SAMPLE NUMBER	LIFT NUMBER	FIELD DENSITY TEST NUMBER	MAP GRID LOCATION	HYDRAULIC CONDUCTIVITY (PERMEABILITY) cm/s	STATUS
(TP)LP-1-1	1	CLD-2	22	4.6 E-08	PASS
LP-1-2	1	CLD-7	25	7.5 E-08	PASS
LP-1-3	1	CLD-10	13	4.1 E-08	PASS
LP-1-4	1	CLD-15	29	4.2 E-08	PASS
LP-1-5	1	CLD-20	5	3.6 E-08	PASS
LP-1-6	1	CLD-23	18	3.9 E-08	PASS
LP-1-7	1	CLD-29	42	3.4 E-08	PASS
LP-1-8	1	CLD-32	56	2.1 E-08	PASS
LP-1-9	1	CLD-37	38	2.9 E-08	PASS
LP-1-10	1	CLD-40	52	2.2 E-08	PASS
LP-1-11	1	CLD-43	60	5.0 E-08	PASS
LP-1-12	1	CLD-48	46	1.8 E-08	PASS
LP-1-13	1	CLD-95	33	3.6 E-08	PASS
LP-1-14	1	CLD-97	49	6.4 E-08	PASS
LP-1-15	1	CLD-238	20	3.1 E-08	PASS
LP-1-16	1	CLD-243	51	3.6 E-08	PASS

SAMPLE NUMBER	LIFT NUMBER	FIELD DENSITY TEST NUMBER	MAP GRID LOCATION	HYDRAULIC CONDUCTIVITY (PERMEABILITY) cm/s	STATUS
(TP)LP-2-1	2	CLD-54	55	5.1 E-08	PASS
LP-2-2	2	CLD-60	41	2.1 E-08	PASS
LP-2-3	2	CLD-62	37	3.6 E-08	PASS
LP-2-4	2	CLD-67	10	3.0 E-08	PASS
LP-2-5	2	CLD-71	12	6.1 E-08	PASS
LP-2-6	2	CLD-121	3	1.7 E-08	PASS
LP-2-7	2	CLD-126	28	3.5 E-08	PASS
LP-2-8	2	CLD-128	59	2.8 E-08	PASS
LP-2-9	2	CLD-133	45	2.5 E-08	PASS
LP-2-10	2	CLD-135	16	3.4 E-08	PASS
LP-2-11	2	CLD-139	31	2.6 E-08	PASS
LP-2-12	2	CLD-142	63	2.5 E-08	PASS
LP-2-13	2	CLD-146	7	2.5 E-08	PASS
LP-2-14	2	CLD-148	64	2.9 E-08	PASS
LP-2-15	2	CLD-157	66	1.7 E-08	PASS
LP-2-16	2	CLD-250	35	2.6 E-08	PASS

Project Specification: $k < 1 \text{ E-}07 \text{ cm/s}$

(TP): Test Pad Sample

Updated on: 5/30/2008

Updated by: Helvey

SUMMARY OF CLAY LINER HYDRAULIC CONDUCTIVITY TESTING

CONSTRUCTION OF CELL NO. 12
EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
BLE Project No. J07-1001-58

Cell No. 12 area = 667,000 sq ft (15.3 Acres) = 48,177 cy Clay Liner

SAMPLE NUMBER	LIFT NUMBER	FIELD DENSITY TEST NUMBER	MAP GRID LOCATION	HYDRAULIC CONDUCTIVITY (PERMEABILITY) cm/s	STATUS
(TP)LP-3-1	3	CLD-72	57	2.0 E-08	PASS
LP-3-2	3	CLD-74	53	2.2 E-08	PASS
LP-3-3	3	CLD-76	54	3.3 E-08	PASS
LP-3-4	3	CLD-86	11	3.3 E-08	PASS
LP-3-5	3	CLD-90	10	2.8 E-08	PASS
LP-3-6	3	CLD-159	27	1.8 E-08	PASS
LP-3-7	3	CLD-163	43	2.6 E-08	PASS
LP-3-8	3	CLD-168	15	2.6 E-08	PASS
LP-3-9	3	CLD-176	61	4.6 E-08	PASS
LP-3-10	3	CLD-180	17	1.5 E-08	PASS
LP-3-11	3	CLD-182	1	1.4 E-08	PASS
LP-3-12	3	CLD-186	47	1.3 E-08	PASS
LP-3-13	3	CLD-192	65	4.9 E-08	PASS
LP-3-14	3	CLD-194	19	3.4 E-08	PASS
LP-3-15	3	CLD-255	67	4.7 E-08	PASS
LP-3-16	3	CLD-262	9	2.80E-08	PASS

Project Specification: $k < 1 \text{ E-07 cm/s}$

(TP): Test Pad Sample

Updated on: 5/30/2008

Updated by: Helvey

SAMPLE NUMBER	LIFT NUMBER	FIELD DENSITY TEST NUMBER	MAP GRID LOCATION	HYDRAULIC CONDUCTIVITY (PERMEABILITY) cm/s	STATUS
(TP)LP-4-1	4	CLD-98	36	2.8 E-08	PASS
LP-4-2	4	CLD-104	26	4.7 E-08	PASS
LP-4-3	4	CLD-106	24	3.5 E-08	PASS
LP-4-4	4	CLD-108	40	2.2 E-08	PASS
LP-4-5	4	CLD-109	39	2.4 E-08	PASS
LP-4-6	4	CLD-201	58	4.7 E-08	PASS
LP-4-7	4	CLD-205	14	2.8 E-08	PASS
LP-4-8	4	CLD-208	44	2.7 E-08	PASS
LP-4-9	4	CLD-214	30	2.0 E-08	PASS
LP-4-10	4	CLD-217	62	4.3 E-08	PASS
LP-4-11	4	CLD-221	6	4.0 E-08	PASS
LP-4-12	4	CLD-225	32	3.9 E-08	PASS
LP-4-13	4	CLD-229	48	2.6 E-08	PASS
LP-4-14	4	CLD-231	19	1.9 E-08	PASS
LP-4-15	4	CLD-266	68	1.80E-08	PASS
LP-4-16	4	CLD-270	21	3.1E-08	PASS

SUMMARY OF HYDRAULIC CONDUCTIVITY TEST RESULTS
WASHED SAND PROTECTIVE COVER

CONSTRUCTION OF CELL NO. 12
EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J07-1001-58

Cell No. 12 [667,000 sq ft (15.3 Acres)]: 6,100 cy washed sand protective cover

SAMPLE NO.	MATERIAL DESCRIPTION	HYDRAULIC CONDUCTIVITY (ASTM D 2434) (Dense) cm/s	PERCENT FINES (<#200 seive) %
PCSP-1-C12	Washed Sand	3.3 E-02	0.8
PCSP-2-C12	Washed Sand	2.5 E-02	2.8
PCSP-3-C12	Washed Sand	4.1 E-02	0.7
PCSP-4-C12	Washed Sand	5.1 E-02	0.8
PCSP-5-C12	Washed Sand	2.9E-02	1.0
PCSP-6-C12	Washed Sand	5.6E-02	0.5
PCSP-7-C12	Washed Sand	2.5E-02	1.0
PCSP-8-C12	Washed Sand	3.3E-02	0.9
PCSP-9-C12	Washed Sand	3.6E-02	---

PROJECT REQUIREMENTS:	$k \geq 1 \text{ E-02 cm/s}$	$\leq 5\%$
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SUMMARY OF HYDRAULIC CONDUCTIVITY TEST RESULTS
NATIVE PROTECTIVE COVER SAND

CONSTRUCTION OF CELL NO. 12
EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J07-1001-58

Cell No. 12 [667,000 sq ft (15.3 Acres)]: 42,100 cy native protective cover sand

SAMPLE NO.	MATERIAL DESCRIPTION	HYDRAULIC CONDUCTIVITY (ASTM D 2434) (Dense) cm/s
PCBW-1-C12	Yellow & brown fi.-med. SAND	4.6E-03
PCBW-2-C12	Yellow & brown fi.-med. SAND	7.9E-03
PCBW-3-C12	Yellow & brown fi.-med. SAND	1.3E-02
PCBW-4-C12	Yellow & brown fi.-med. SAND	2.6E-03
PCBW-5-C12	Yellow & brown fi.-med. SAND	1.5E-02
PCBW-6-C12	Yellow & brown fi.-med. SAND	7.8E-03
PCBW-7-C12	Yellow & brown fi.-med. SAND	8.2E-03
PCBW-8-C12	Yellow & brown fi.-med. SAND	8.0E-03
PCBW-9-C12	Yellow & brown fi.-med. SAND	6.1E-03
PCBW-10-C12	Yellow & brown fi.-med. SAND	9.3 E-03
PCBW-11-C12	Yellow & brown fi.-med. SAND	6.5 E-03
PCBW-12-C12	Yellow & brown fi.-med. SAND	1.3 E-02
PCBW-13-C12	Yellow & brown fi.-med. SAND	2.1 E-03
PCBW-14-C12	Yellow & brown fi.-med. SAND	5.8E-03
PCBW-15-C12	Yellow & brown fi.-med. SAND	4.3E-03

PROJECT REQUIREMENTS:

$k \geq 1 \text{ E-03 cm/s}$

FIELD DENSITY GRIDMAP CHECKLIST

CONSTRUCTION QUALITY ASSURANCE - CELL NO.12 EAST CAROLOINA REGIONAL MSW LANDFILL MONTGOMERY COUNTY, NORTH CAROLINA

BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J07-1001-58

Cell No. 12 = 759,000 sq ft (17.5 Acres) = 40,170 cy Soil Liner

MAP GRID NUMBER	FIELD DENSITY TEST NUMBER			
	SUBGRADE	LIFT NO. 1	LIFT NO. 2	LIFT NO. 3
1	SFD-220	CLD-25	CLD-147	CLD-182
2	SFD-221	CLD-236	CLD-153	CLD-196
3	SFD-214	CLD-14	CLD-121	CLD-166
4	SFD-215	CLD-17	CLD-123	CLD-167
5	SFD-216	CLD-20	CLD-136	CLD-172
6	SFD-217	CLD-22	CLD-141	CLD-181
7	SFD-218	CLD-24	CLD-146	CLD-183
8	SFD-219	CLD-27	CLD-152	CLD-195
9	SFD-314	CLD-237	CLD-247	CLD-262
10	SFD-159	CLD-4	CLD-67	CLD-90
11	SFD-160	CLD-6	CLD-69	CLD-86
12	SFD-161	CLD-8	CLD-71	CLD-85
13	SFD-162	CLD-10	CLD-119	CLD-158
14	SFD-190	CLD-13	CLD-120	CLD-165
15	SFD-191	CLD-16	CLD-122	CLD-168
16	SFD-192	CLD-19	CLD-135	CLD-173
17	SFD-193	CLD-21	CLD-140	CLD-180
18	SFD-194	CLD-23	CLD-145	CLD-184
19	SFD-195	CLD-26	CLD-151	CLD-194
20	SFD-315	CLD-238	CLD-248	CLD-260
21	SFD-316	CLD-239	CLD-249	CLD-261
22	SFD-103	CLD-2	CLD-64	CLD-91
23	SFD-165	CLD-3	CLD-65	CLD-89
24	SFD-102	CLD-5	CLD-66	CLD-88
25	SFD-106	CLD-7	CLD-68	CLD-87
26	SFD-163	CLD-9	CLD-70	CLD-84
27	SFD-164	CLD-11	CLD-118	CLD-159
28	SFD-182	CLD-12	CLD-126	CLD-164
29	SFD-183	CLD-15	CLD-129	CLD-169
30	SFD-184	CLD-18	CLD-132	CLD-174
31	SFD-185	CLD-49	CLD-139	CLD-179
32	SFD-186	CLD-51	CLD-144	CLD-185
33	SFD-187	CLD-95	CLD-150	CLD-188
34	SFD-317	CLD-240	CLD-256	CLD-267

MAP GRID NUMBER	FIELD DENSITY TEST NUMBER			
	SUBGRADE	LIFT NO. 1	LIFT NO. 2	LIFT NO. 3
35	SFD-318	CLD-241	CLD-250	CLD-259
36	SFD-158	CLD-1	CLD-63	CLD-83
37	SFD-99	CLD-39	CLD-62	CLD-82
38	SFD-100	CLD-37	CLD-59	CLD-81
39	SFD-101	CLD-35	CLD-61	CLD-80
40	SFD-105	CLD-33	CLD-58	CLD-79
41	SFD-136	CLD-31	CLD-60	CLD-78
42	SFD-137	CLD-29	CLD-124	CLD-160
43	SFD-181	CLD-42	CLD-127	CLD-163
44	SFD-180	CLD-44	CLD-130	CLD-170
45	SFD-179	CLD-46	CLD-133	CLD-175
46	SFD-178	CLD-48	CLD-138	CLD-178
47	SFD-177	CLD-50	CLD-143	CLD-186
48	SFD-176	CLD-94	CLD-149	CLD-189
49	SFD-175	CLD-97	CLD-155	CLD-191
50	SFD-319	CLD-242	CLD-251	CLD-257
51	SFD-322	CLD-243	CLD-252	CLD-258
52	SFD-157	CLD-40	CLD-57	CLD-77
53	SFD-81R	CLD-38	CLD-56R	CLD-74
54	SFD-82	CLD-36	CLD-55	CLD-76
55	SFD-83R	CLD-34	CLD-54	CLD-73
56	SFD-84	CLD-32	CLD-53	CLD-75
57	SFD-85R	CLD-30R	CLD-52	CLD-72
58	SFD-86R	CLD-28	CLD-125	CLD-161
59	SFD-168	CLD-41	CLD-128	CLD-162
60	SFD-169	CLD-43	CLD-131	CLD-171
61	SFD-170	CLD-45	CLD-134	CLD-176
62	SFD-171	CLD-47	CLD-137	CLD-177
63	SFD-172	CLD-92	CLD-142	CLD-187
64	SFD-173	CLD-93	CLD-148	CLD-190
65	SFD-174	CLD-96	CLD-154	CLD-192
66	SFD-320	CLD-244	CLD-157	CLD-193
67	SFD-321	CLD-245	CLD-253	CLD-255
68	SFD-323	CLD-246	CLD-254	CLD-256

FIELD GRAINSIZE GRIDMAP CHECKLIST - PAGE 1

CONSTRUCTION QUALITY ASSURANCE - CELL 12 EAST CAROLINA REGIONAL MSW LANDFILL BERTIE COUNTY, NORTH CAROLINA

BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J07-1001-58

Cell No. 12 = 667,000 sq ft (15.3 Acres) = 50,000 cy Clay Liner

PAGE 1 OF 2

MAP GRID NUMBER	Bottom 18 inches < 3-inch sieve Top 6 inches < 1-inch sieve			
	LIFT NO. 1	LIFT NO. 2	LIFT NO. 3	LIFT NO. 4
1	PASS		PASS	
2		PASS		PASS
3	PASS		PASS	
4		PASS		PASS
5	PASS		PASS	
6		PASS		PASS
7	PASS		PASS	
8		PASS		PASS
9	PASS		PASS	
10		PASS		PASS
11	PASS		PASS	
12		PASS		PASS
13	PASS		PASS	
14		PASS		PASS
15	PASS		PASS	
16		PASS		PASS
17	PASS		PASS	
18		PASS		PASS
19	PASS		PASS	
20		PASS		PASS
21		PASS		PASS
22	PASS		PASS	
23		PASS		PASS
24	PASS		PASS	
25		PASS		PASS
26	PASS		PASS	
27		PASS		PASS
28	PASS		PASS	
29		PASS		PASS
30	PASS		PASS	
31		PASS		PASS
32	PASS		PASS	
33		PASS		PASS
34	PASS		PASS	

MIN. NUMBER OF TESTS PER LIFT	LIFT NO. 1 17	LIFT NO. 2 17	LIFT NO. 3 17	LIFT NO. 4 17
NUMBER OF TESTS REQUIRED:	68			
NUMBER OF TESTS PERFORMED:	68			

Maximum Particle Size Criteria: Bottom 18 inches < 3-inch sieve
Top 6 inches < 1-inch sieve

Note (1): Each test represents 20,000 sf of each lift.

FIELD GRAINSIZE GRIDMAP CHECKLIST - PAGE 2

CONSTRUCTION QUALITY ASSURANCE - CELL 12

EAST CAROLINA REGIONAL MSW LANDFILL

BERTIE COUNTY, NORTH CAROLINA

BUNNELL-LAMMONS ENGINEERING, INC. PROJECT NO. J07-1001-58

Cell No. 12 = 667,000 sq ft (15.3 Acres) = 50,000 cy Clay Liner

PAGE 2 OF 2

MAP GRID NUMBER	Bottom 18 inches < 3-inch sieve Top 6 inches < 1-inch sieve			
	LIFT NO. 1	LIFT NO. 2	LIFT NO. 3	LIFT NO. 4
35		PASS		PASS
36	PASS		PASS	
37		PASS		PASS
38	PASS		PASS	
39		PASS		PASS
40	PASS		PASS	
41		PASS		PASS
42	PASS		PASS	
43		PASS		PASS
44	PASS		PASS	
45		PASS		PASS
46	PASS		PASS	
47		PASS		PASS
48	PASS		PASS	
49		PASS		PASS
50	PASS		PASS	
51	PASS		PASS	
52		PASS		PASS
53	PASS		PASS	
54		PASS		PASS
55	PASS		PASS	
56		PASS		PASS
57	PASS		PASS	
58		PASS		PASS
59	PASS		PASS	
60		PASS		PASS
61	PASS		PASS	
62		PASS		PASS
63	PASS		PASS	
64		PASS		PASS
65	PASS		PASS	
66		PASS		PASS
67	PASS		PASS	
68		PASS		PASS

MIN. NUMBER OF TESTS PER LIFT	LIFT NO. 1	LIFT NO. 2	LIFT NO. 3	LIFT NO. 4
	17	17	17	17
NUMBER OF TESTS REQUIRED:	68			
NUMBER OF TESTS PERFORMED:	68			

Maximum Particle Size Criteria: Bottom 18 inches < 3-inch sieve

Top 6 inches < 1-inch sieve

Note (1): Each test represents 20,000 sf of each lift.

SUMMARY OF DESIGN AND OPERATION PLAN HDPE GEOMEMBRANE TEST FREQUENCY REQUIREMENTS

EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12

Bunnell-Lammons Engineering, Inc. Project No. J07-1001-58

NONTEXTURED HDPE GEOMEMBRANE MANUFACTURED FOR PROJECT

MATERIAL	NUMBER OF ROLLS
SMOOTH	46

TOTAL AREA OF CELL = 660,000 sf (15 acres)

TOTAL WEIGHT OF GEOMEMBRANE = 177,772 lbs.

TOTAL WEIGHT OF RESIN = 189,600 lbs. for smooth geomembrane (total weight of the lot from which this geomembrane was manufactured)

TESTING REQUIREMENTS

TEST	CQA PLAN					
	REQUIRED FREQUENCY		NO. OF REQUIRED TESTS		NO. OF PERFORMED TESTS	
	CQC	CQA	CQC	CQA	CQC	CQA
			Smooth	Smooth	Smooth	Smooth
MANUFACTURED SHEET						
THICKNESS (ASTM D 5199)	Every roll	Every Roll	46	46	46	46
SHEET DENSITY (ASTM D 792) OR (ASTM D 1505)	1 per 200,000 lbs. ⁽²⁾	SEE NOTE 1	1	4	12	4
TENSILE PROPERTIES (ASTM D 6693, GRI GM13)	1 per 20,000 lbs. ⁽³⁾	SEE NOTE 1	9	4	12	4
TEAR RESISTANCE (ASTM D 1004)	1 per 45,000 lbs. ⁽³⁾	SEE NOTE 1	4	4	12	4
NCTL (ASTM D 5397, GRI GM-10)	1 per resin lot	NONE	1	---	12	---
PUNCTURE RESISTANCE (ASTM D 4833)	1 per 45,000 lbs. ⁽³⁾	NONE	4	---	12	---
CARBON BLACK CONTENT (ASTM D 1603) OR (ASTM D 4218)	1 per 20,000 lbs. ⁽³⁾	SEE NOTE 1	9	4	12	4
CARBON BLACK DISPERSION (ASTM D 5596, Category 1 or 2)	1 per 45,000 lbs. ⁽³⁾	NONE	4	---	12	---
MELT INDEX (ASTM D 1238)	NONE	SEE NOTE 1	---	4	---	4

NOTE (1): Cube root of the total number of rolls

NOTE (2): Pounds of resin

NOTE (3): Pounds of geomembrane

**POLY-FLEX LINER
LIMITED WARRANTY**

Warranty No.: 08 - 135 - 47
Project No.: 277329
Effective Date: 1 / 7 / 2008

USER: <u>Republic Services, Inc.</u>	PROJECT NAME: <u>East Carolina Environmental</u>
ADDRESS: <u>9650 Oxford Road</u>	DESCRIPTION: <u>Landfill</u>
CITY, STATE, ZIP: <u>Rougemount, NC 27572</u>	ADDRESS: <u>1922 Republican Road</u>
	CITY, STATE, ZIP: <u>Aulander, NC 27805</u>

POLY-FLEX, INC. warrants each Poly-Flex Liner to be free from defects in materials and to be able to withstand normal weathering from the date of installation for a period of twenty (20) years for normal use in approved applications.

This Limited Warranty does not include damages or defects in the Poly-Flex Liner resulting from acts of God, casualty or catastrophe including but not limited to: earthquakes, floods, piercing hail, tornados or force majeure. The term "normal use" as used herein does not include, among other things, the exposure of the Poly-Flex Liner to harmful chemicals, abuse of the Poly-Flex Liner by machinery, equipment or people, excessive pressures or stress from any source. This Limited Warranty is intended for commercial use only and is not in effect for a "consumer" as defined in the Magnuson-Moss Warranty Act or any similar federal, state, or local statutes.

Should defects or premature loss of use within the scope of the above Limited Warranty occur, Poly-Flex, Inc. will, at its option, repair or replace the Poly-Flex Liner on a pro-rata basis at the then current price in such manner as to charge the Purchaser/User only for that portion of the warranted life which has elapsed since purchase of the material. Poly-Flex, Inc. will have the right to inspect and determine the cause of any alleged defect in the Poly-Flex Liner and to take appropriate steps to repair or replace the Poly-Flex Liner if a defect exists and is within the term of this Limited Warranty.

Any claim for any alleged breach of this Limited Warranty must be made in writing, by certified mail, to the President of Poly-Flex, Inc. within thirty (30) days after the alleged defect is first noticed. Should the required notice not be given, the defect and all warranties shall be deemed to have been waived by the Purchaser/User, and Purchaser/User shall have no right of recovery against Poly-Flex, Inc. In the event repairs and/or replacements are to be effected, said repairs and/or replacements shall not become due until the area subject to repair and/or replacement of Poly-Flex Liner is available in a clean, dry, unencumbered condition, including without limitation being free from all water, dirt, sludge, residuals, and liquids of any kind.

Poly-Flex, Inc.'s, and its related entities', officers', shareholders', affiliates', agents', assigns', and successors' liability under this Limited Warranty shall in no event exceed the replacement cost of the material for the particular installation. Further, under no circumstances shall Poly-Flex, Inc., and/or its related entities, officers, shareholders, affiliates, agents, assigns and/or successors be liable for any special, direct, indirect, or consequential damages arising from loss of production or any other losses, including losses due to personal injuries and product liability, owing to the failure of the material or improper installation and no allowance will be made for repairs, replacements, or alterations made by the Purchaser/User without the express written consent of an officer of Poly-Flex, Inc.

BY USE OF THIS PRODUCT IT IS AGREED THAT ANY CONTROVERSY OR CLAIM ARISING OUT OF OR RELATING TO SAID USE SHALL BE DECIDED BY BINDING ARBITRATION IN ACCORDANCE WITH THE UNITED STATES ARBITRATION ACT (Title 9, U.S. Code) IN DALLAS, TEXAS. THE ARBITRATION SHALL BE CONDUCTED BY A MUTUALLY AGREEABLE ARBITRATOR. IF THE PARTIES ARE UNABLE TO AGREE UPON AN ARBITRATOR, THEN EACH PARTY SHALL PICK AN INDIVIDUAL QUALIFIED TO SERVE AS AN ARBITRATOR AND THOSE TWO INDIVIDUALS SHALL THEN APPOINT A THIRD ARBITRATOR. THE ARBITRATOR'S AWARD SHALL BE FINAL AND MAY BE CONFIRMED BY THE JUDGMENT OF A STATE OR FEDERAL COURT IN THE JURISDICTION WHERE THE ARBITRATION OCCURRED. THE ARBITRATOR(S) SHALL HAVE NO POWER OR AUTHORITY TO AWARD EXEMPLARY OR PUNITIVE DAMAGES, OR TO ALTER, AMEND, OR SUPPLEMENT ANY TERM, CONDITION, OR PROVISION OF THIS AGREEMENT. THE PARTIES

CONSENT TO JURISDICTION AND VENUE IN COMPETENT STATE AND FEDERAL COURTS IN DALLAS, TEXAS. EACH PARTY SHALL BEAR ITS OWN ATTORNEY'S FEES, REGARDLESS OF THE OUTCOME OF THE ARBITRATION. ALL COSTS OF ARBITRATION, INCLUDING BUT NOT LIMITED TO FILING FEES, ARBITRATOR(S) FEES, AND STENOGRAPHER FEES, SHALL BE SHARED EQUALLY BY THE PARTIES.

Poly-Flex, Inc. neither assumes nor authorizes any person other than an officer of Poly-Flex, Inc. to assume for it any other or additional liability in connection with the Poly-Flex Liner made the basis of this Limited Warranty. The Limited Warranty on the Poly-Flex Liner herein is given in lieu of all other possible warranties, either express or implied, including warranties of merchantability and of fitness for a particular purpose and by accepting delivery of the material, Purchaser/User waives all other possible warranties, except those specifically given.

The parties expressly agree that the sale of the Poly-Flex Liner is for commercial or industrial use only.

The Poly-Flex Liner Limited Warranty is extended to the Purchaser/User and is non-transferable and non-assignable, without the written consent of an officer of Poly-Flex, Inc.

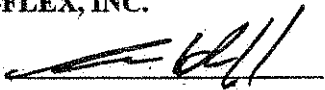
POLY-FLEX, INC. MAKES NO WARRANTY OF ANY KIND OTHER THAN THAT GIVEN ABOVE AND HEREBY DISCLAIMS ALL WARRANTIES, BOTH EXPRESS OR IMPLIED, OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE.

If any provision of this Warranty shall be found to be illegal, invalid, or unenforceable under the present or future laws, such provision shall be fully severable and the remaining provisions shall remain in full force and effect. Any provision of this Warranty held illegal, invalid, or unenforceable shall remain in full force and effect to the extent not so held. In lieu of the provision held illegal, invalid, or unenforceable, there shall be automatically added as part of this Warranty a provision as similar in its terms to such invalid provision as may be possible and may be legal, valid, and enforceable.

I have read and agree to be bound by the terms and conditions of the foregoing warranty. The said warranty shall not be honored until an original dated and signed copy, by an authorized representative of User, has been duly returned to Poly-Flex and until full payment has been made to Poly-Flex.

POLY-FLEX, INC.

By:



Its:

Vice-President

USER: _____

By: _____

Its: _____

POLY-FLEX, INC.

2000 W. Marshall Drive

Grand Prairie, TX 75051

SUMMARY OF CQA CONFORMANCE TEST RESULTS HDPE GEOMEMBRANE

EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
Bunnell-Launious Engineering, Inc. Project No. J07-1001-58

Material: 60 mil Smooth HDPE Geomembrane
Manufacturer: Poly-Flex, Inc.

CONFORMANCE TEST (2)	REQUIRED TEST VALUE	CONFORMANCE TEST RESULT			
		Roll Number/Resin Batch Number			
		HS2-6-07-6085-5 8271447	HS2-6-07-6095-5 8271447	HS2-6-07-6105-5 8271447	HS2-6-07-6115-5 8271447
Thickness (2) (mils) ASTM D 5199	≥ 60	61	61	60	61
Sheet Density (grams/cc) ASTM D 1505	≥ 0.94	0.9498	0.949	0.9488	0.9486
Carbon Black Content (%) ASTM D 1603	2 to 3	2.38	2.39	2.36	2.38
Tensile Properties ASTM D 638	Strength (3)	At Yield, ppi	216/207	203/205	201/203
		At Break, ppi	375/329	323/350	325/363
Tensile Properties ASTM D 638	Elongation (3)	At Yield, %	18/18	18/17	18/17
		At Break, %	801/784	768/821	775/828
Tear Resistance (1) (pounds) ASTM D 1004 Die C	≥ 42	59/56	59/55	59/55	57/53
Melt Index (grams/10 minutes) ASTM D 1238	NONE	0.1040	0.1054	0.1062	0.1016
APPROVED		YES	YES	YES	YES

NOTE (1): Test values are machine direction / transverse direction.
NOTE (2): Lowest individual measurement shown. All 46 rolls achieved ≥ 60 mil thickness.

SUMMARY OF MANUFACTURER (CQC) CONFORMANCE TEST RESULTS

HDPE GEOMEMBRANE

EAST CAROLINA REGIONAL MSW LANDFILL
 BERTIE COUNTY, NORTH CAROLINA
 CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
 Bunnell-Lammons Engineering, Inc. Project No. 107-1001-58

Material: 60 mil Smooth HDPE Geomembrane
 Manufacturer: Poly-Flex, Inc.

CONFORMANCE ⁽¹⁾		CONFORMANCE TEST RESULT			
TEST	REQUIRED TEST VALUE	Roll Number/Resin Batch Number			
		HS2-6-07-6076-5 8271447	HS2-6-07-6080-5 8271447	HS2-6-07-6084-5 8271447	HS2-6-07-6088-5 8271447
Sheet Density (grams/cc) ASTM D 1505	≥ 0.94	0.947	0.947	0.947	0.947
Thickness ⁽²⁾ (mils) ASTM D 5199	≥ 60	60	61	60	61
Carbon Black Content (%) ASTM D 1603	2.0 to 3.0	2.5	2.5	2.3	2.3
Tensile Properties ASTM D 6693	Strength	At Yield, ppi	163	168	172
		At Break, ppi	310	329	339
Tensile Properties ASTM D 6693	Elongation	At Yield, %	21	18	21
		At Break, %	781	893	937
Puncture Resistance (pounds) ASTM D 4833	≥ 90	154	154	161	157
Tear Resistance (pounds) ASTM D 1004	≥ 42	56	51	57	53
Carbon Black Dispersion ASTM D 5596	Cat 1 or 2	1	1	1	1
NCITL (hrs.) ASTM D 5597	≥ 300	PASS	PASS	PASS	PASS
APPROVED		YES	YES	YES	YES

NOTE: All 46 rolls manufactured for the East Carolina Regional MSW Landfill project meet Thickness (ASTM D5199) requirements. The resin lots passed NCITL testing.

SUMMARY OF MANUFACTURER (CQC) CONFORMANCE TEST RESULTS

HDPE GEOMEMBRANE

EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
Bunnell-Lammons Engineering, Inc. Project No. J07-1001-58

Material: 60 mil Smooth HDPE Geomembrane
Manufacturer: Poly-Flex, Inc.

CONFORMANCE ⁽¹⁾		REQUIRED TEST VALUE	CONFORMANCE TEST RESULT			
TEST			Roll Number/Resin Batch Number			
			HS2-6-07-6096-5 8271447	HS2-6-07-6100-5 8271447	HS2-6-07-6104-5 8271447	HS2-6-07-6112-5 8271447
Sheet Density (grams/cc) ASTM D 1505		≥ 0.94	0.947	0.947	0.947	0.948
Thickness ⁽²⁾ (mils) ASTM D 5199		≥ 60	60	61	60	60
Carbon Black Content (%) ASTM D 1603		2.0 to 3.0	2.3	2.3	2.4	2.3
Tensile Properties ASTM D 6693	Strength	At Yield, ppi ≥ 126	176	172	171	163
		At Break, ppi ≥ 90	343	329	343	323
Tensile Properties ASTM D 6693	Elongation	At Yield, % ≥ 12	18	21	18	21
		At Break, % ≥ 100	929	834	940	836
Puncture Resistance (pounds) ASTM D 4833		≥ 90	156	161	151	153
Tear Resistance (pounds) ASTM D 1004		≥ 42	54	58	53	57
Carbon Black Dispersion ASTM D 5596		Cat 1 or 2	1	1	1	1
NCTL (hrs.) ASTM D 5397		≥ 300	PASS	PASS	PASS	PASS
APPROVED			YES	YES	YES	YES

NOTE: All 46 rolls manufactured for the East Carolina Regional MSW Landfill project meet Thickness (ASTM D5199) requirements. The resin lots passed NCTL testing.

SUMMARY OF MANUFACTURER (CQC) CONFORMANCE TEST RESULTS

HDPE GEOMEMBRANE

EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
Bunnell-Lammons Engineering, Inc. Project No. J07-1001-58

Material: 60 mil Smooth HDPE Geomembrane
Manufacturer: Poly-Flex, Inc.

CONFORMANCE ⁽¹⁾		REQUIRED TEST VALUE	CONFORMANCE TEST RESULT	
TEST			Roll Number/Resin Batch Number	
			HS2-6-07-6116-5 8271447	HS2-6-07-6120-5 8271447
Sheet Density (grams/cc) ASTM D 1505		≥ 0.94	0.948	0.947
Thickness ⁽²⁾ (mils) ASTM D 5199		≥ 60	60	61
Carbon Black Content (%) ASTM D 1603		2.0 to 3.0	2.2	2.3
Tensile Properties ASTM D 6693	Strength	At Yield, ppi ≥ 126	171	179
		At Break, ppi ≥ 90	308	346
Tensile Properties ASTM D 6693	Elongation	At Yield, % ≥ 12	21	18
		At Break, % ≥ 100	800	915
Puncture Resistance (pounds) ASTM D 4833		≥ 90	154	159
Tear Resistance (pounds) ASTM D 1004		≥ 42	58	54
Carbon Black Dispersion ASTM D 5596		Cat 1 or 2	1	1
NCTL (hrs.) ASTM D 5397		≥ 300	PASS	PASS
APPROVED			YES	YES

NOTE: All 46 rolls manufactured for the East Carolina Regional MSW Landfill project meet Thickness (ASTM D5199) requirements. The resin lots passed NCTL testing.

SUMMARY OF DESIGN AND OPERATION PLAN HDPE GEOMEMBRANE TEST FREQUENCY REQUIREMENTS

EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12

Bunnell-Lammons Engineering, Inc. Project No. J07-1001-58

TEXTURED HDPE GEOMEMBRANE MANUFACTURED FOR PROJECT

MATERIAL	NUMBER OF ROLLS
TEXTURED	16

TOTAL AREA OF CELL = 660,000 sf (15 acres)

TOTAL WEIGHT OF GEOMEMBRANE = 65,981 lbs.

TOTAL WEIGHT OF RESIN = 192,500 lbs. for textured geomembrane (total weight of the lot from which this geomembrane was manufactured).

TESTING REQUIREMENTS

TEST	CQA PLAN					
	REQUIRED FREQUENCY		NO. OF REQUIRED TESTS		NO. OF PERFORMED TESTS	
	CQC	CQA	CQC	CQA	CQC	CQA
			Textured	Textured	Textured	Textured
MANUFACTURED SHEET						
THICKNESS (ASTM D 5994)	Every roll	Every roll	16	16	16	16
SHEET DENSITY (ASTM D 792) OR (ASTM D 1505)	1 per 200,000 lbs. ⁽²⁾	SEE NOTE 1	1	3	5	3
TENSILE PROPERTIES (ASTM D 6693, GRI GM13)	1 per 20,000 lbs. ⁽³⁾	SEE NOTE 1	4	3	5	3
TEAR RESISTANCE (ASTM D 1004)	1 per 45,000 lbs. ⁽³⁾	SEE NOTE 1	2	3	5	3
NCTL (ASTM D 5397, GRI GM-10)	1 per resin lot	NONE	1	---	1	---
PUNCTURE RESISTANCE (ASTM D 4833)	1 per 45,000 lbs. ⁽³⁾	NONE	2	---	5	---
CARBON BLACK CONTENT (ASTM D 1603) OR (ASTM D 4218)	1 per 20,000 lbs. ⁽³⁾	SEE NOTE 1	4	3	5	3
CARBON BLACK DISPERSION (ASTM D 5596, Category 1 or 2)	1 per 45,000 lbs. ⁽³⁾	NONE	2	---	5	---
ASPERITY HEIGHT (GRI GM-12))	1 per 2 rolls	NONE	8	---	16	---
MELT INDEX (ASTM D 1238)	NONE	SEE NOTE 1	---	3	---	3

NOTE (1): Cube root of the total number of rolls

NOTE (2): Pounds of resin

NOTE (3): Pounds of geomembrane

SUMMARY OF CQA CONFORMANCE TEST RESULTS

HDPE GEOMEMBRANE

EAST CAROLINA REGIONAL MSW LANDFILL
BERTIE COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
Bunnell-Lammons Engineering, Inc. Project No. J07-1001-58

Material: 60 mil Textured HDPE Geomembrane
Manufacturer: Poly-Flex, Inc.

CONFORMANCE TEST (2)		REQUIRED TEST VALUE	CONFORMANCE TEST RESULT			
			Roll Number/Resin Batch Number			
			HT1-6-07-7604-5 8271440	HT1-6-07-7610-05 8271440	HT1-6-07-7617-05 8271440	—
Thickness (mils) ASTM D 5994		≥ 60	60	60	61	—
Sheet Density (grams/cc) ASTM D 1505		≥ 0.94	0.9497	0.9490	0.9488	—
Carbon Black Content (%) ASTM D 1603		2 to 3	2.44	2.36	2.39	—
Tensile Properties ASTM D 638	Strength (3)	At Yield, ppi ≥ 126	211/212	201/205	220/211	—
		At Break, ppi ≥ 90	276/213	257/192	250/219	—
Tensile Properties ASTM D 638	Elongation (3)	At Yield, % ≥ 12	18/17	18/17	17/17	—
		At Break, % ≥ 100	550/500	517/410	485/482	—
Tear Resistance (1) (pounds) ASTM D 1004 Die C		≥ 42	61/60	63/58	61/56	—
Melt Index (grams/10 minutes) ASTM D 1238		NONE	0.2256	0.2197	0.2039	—
APPROVED			YES	YES	YES	—

NOTE (1): Test values are machine direction / transverse direction.
NOTE (2): Lowest individual measurement shown. All 16 textured rolls achieved ≥ 60 mil thickness.

SUMMARY OF MANUFACTURER (CQC) CONFORMANCE TEST RESULTS

HDPE GEOMEMBRANE

EAST CAROLINA REGIONAL MSW LANDFILL
 BERTIE COUNTY, NORTH CAROLINA
 CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
 Bunnell-Lammonis Engineering, Inc. Project No. J07-1001-58

Material: 60 mil Textured HDPE Geomembrane
 Manufacturer: Poly-Flex, Inc.

CONFORMANCE ⁽¹⁾		CONFORMANCE TEST RESULT				
TEST	REQUIRED TEST VALUE	Roll Number/Resin Batch Number				
		HTI-6-07-7604-5 8271440	HTI-6-07-7609-5 8271440	HTI-6-07-7612-5 8271440	HTI-6-07-7616-5 8271440	HTI-6-07-7621-5 8271440
Sheet Density (grams/cc) ASTM D 1505	≥ 0.94	0.948	0.948	0.948	0.948	0.948
Thickness ⁽²⁾ (mils) ASTM D 5994	≥ 60	60	61	60	61	61
Asperity (mil) GRI GM 12	≥ 10	22/21	23/22	23/23	22/23	21/23
Carbon Black Content (%) ASTM D 1603	2.0 to 3.0	2.5	2.4	2.3	2.4	2.5
Tensile Properties ASTM D 6693	Strength	At Yield, ppi	175	176	177	176
	At Break, ppi	172	193	181	167	175
Tensile Properties ASTM D 6693	Elongation	At Yield, %	18	18	19	18
	At Break, %	472	525	473	450	475
Puncture Resistance (pounds) ASTM D 4833	≥ 90	151	157	160	154	154
Tear Resistance (pounds) ASTM D 1004 Die C	≥ 42	55	57	57	54	55
Carbon Black Dispersion ASTM D 5596	Cat 1 or 2	1	1	1	1	1
NCTL (hrs.) ASTM D 5397	≥ 300	PASS	PASS	PASS	PASS	PASS
APPROVED		YES	YES	YES	YES	YES

NOTE: All 16 rolls manufactured for the East Carolina Regional MSW Landfill project meet Thickness (ASTM D5994) and Asperity Height (GRI GM12) requirements. The resin lots passed NCTL testing.

SUMMARY OF MANUFACTURER (CQC) CONFORMANCE TEST RESULTS
HDPE GEOMEMBRANE

UWHARRIE REGIONAL MSW LANDFILL
MONTGOMERY COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
Bunnell-Lammons Engineering, Inc. Project No. J07-1002-78

Roll # 5
HTI-6-07-7522-5
HTI-6-07-7547-5
TRANSFERRED
TO EAST CAROLINA

Material: 60 mil Textured HDPE Geomembrane
Manufacturer: Poly-Flex, Inc.

CONFORMANCE TEST			REQUIRED TEST VALUE	CONFORMANCE TEST RESULT				
				Roll Number/Resin Batch Number				
				HT1-6-07-7520-5 8271517	HT1-6-07-7525-5 8271517	HT1-6-07-7528-5 8271517	HT1-6-07-7533-5 8271517	HT1-6-07-7536-5 8271517
Thickness (mils) ASTM D 5994			≥ 60	60	60	60	61	60
Carbon Black Content (%) ASTM D 1603			2 to 3	2.7	2.7	2.6	2.7	2.6
Tear Resistance (pounds) ASTM D 1004 Die C			≥ 42	57	54	56	57	57
Puncture Resistance (pounds) ASTM D 4833			≥ 90	152	154	152	158	149
Tensile Prop. ASTM D 638	Strength	At Yield, ppi	≥ 126	171	168	171	174	171
		At Break, ppi	≥ 90	164	180	178	192	174
Tensile Properties ASTM D 638	Elongation	At Yield, %	≥ 12	19	18	17	19	19
		At Break, %	≥ 100	394	502	460	515	472
Carbon Dispersion (Category) ASTM D 5596			Cat 1 or 2	1	1	1	1	1
Sheet Density (grams/cc) ASTM D 1505			≥ 0.94	0.948	0.947	0.947	0.947	0.947
NCTL (hrs.) ASTM D 5397			≥ 300	PASS	PASS	PASS	PASS	PASS
Asperity Height (mils) GRI GM 12			≥ 10	24/24	20/20	20/20	21/23	21/21
APPROVED				YES	YES	YES	YES	YES

NOTE: All 71 rolls manufactured for the Uwharrie Regional MSW Landfill project meet Thickness (ASTM D5994) and Asperity Height (GRI GM12) requirements. The resin lots passed NCTL testing.

**SUMMARY OF MANUFACTURER (CQC) CONFORMANCE TEST RESULTS
HDPE GEOMEMBRANE**

UWHARRIE REGIONAL MSW LANDFILL
MONTGOMERY COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
Bunnell-Lammons Engineering, Inc. Project No. J07-1002-78

Roll # 5
HT1-6-07-7522-5
HT1-6-07-7547-5
TRANSFERRED TO EAST
CAROLINA

Material: 60 mil Textured HDPE Geomembrane
Manufacturer: Poly-Flex, Inc.

CONFORMANCE TEST			REQUIRED TEST VALUE	CONFORMANCE TEST RESULT				
				Roll Number/Resin Batch Number				
				HT1-6-07-7540-5 8271517	HT1-6-07-7544-5 8271517	HT1-6-07-7548-5 8271517	HT1-6-07-7553-5 8271517	HT1-6-07-7556-5 8271517
Thickness (mils) ASTM D 5994			≥ 60	60	61	60	60	60
Carbon Black Content (%) ASTM D 1603			2 to 3	2.2	2.6	2.6	2.5	2.6
Tear Resistance (pounds) ASTM D 1004 Die C			≥ 42	54	53	54	59	57
Puncture Resistance (pounds) ASTM D 4833			≥ 90	158	155	153	153	153
Tensile Prop. ASTM D 638	Strength	At Yield, ppi	≥ 126	167	163	163	185	181
		At Break, ppi	≥ 90	167	162	170	175	171
Tensile Properties ASTM D 638	Elongation	At Yield, %	≥ 12	18	18	18	17	18
		At Break, %	≥ 100	477	420	446	457	469
Carbon Dispersion (Category) ASTM D 5596			Cat 1 or 2	1	1	1	1	1
Sheet Density (grams/cc) ASTM D 1505			≥ 0.94	0.948	0.948	0.948	0.948	0.948
NCTL (hrs.) ASTM D 5397			≥ 300	PASS	PASS	PASS	PASS	PASS
Asperity Height (mils) GRI GM 12			≥ 10	21/23	19/19	19/19	25/25	24/25
APPROVED				YES	YES	YES	YES	YES

NOTE: All 71 rolls manufactured for the Uwharrie Regional MSW Landfill project meet Thickness (ASTM D5994) and Asperity Height (GRI GM12) requirements. The resin lots passed NCTL testing.

SUMMARY OF MANUFACTURER (CQC) CONFORMANCE TEST RESULTS
HDPE GEOMEMBRANE

UWHARRIE REGIONAL MSW LANDFILL
MONTGOMERY COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
Bunnell-Lammons Engineering, Inc. Project No. J07-1002-78

Roll # 5
HTI-6-07-7522-5
HTI-6-07-7547-5
TRANSFERRED TO
EAST CAROLINA

Material: 60 mil Textured HDPE Geomembrane
Manufacturer: Poly-Flex, Inc.

CONFORMANCE TEST			REQUIRED TEST VALUE	CONFORMANCE TEST RESULT				
				Roll Number/Resin Batch Number				
				HTI-6-07-7560-5 8271517	HTI-6-07-7565-5 8271517	HTI-6-07-7568-5 8271517	HTI-6-07-7572-5 8271517	HTI-6-07-7576-5 8271519
Thickness (mils) ASTM D 5994			≥ 60	61	61	60	61	60
Carbon Black Content (%) ASTM D 1603			2 to 3	2.3	2.5	2.5	2.5	2.6
Tear Resistance (pounds) ASTM D 1004 Die C			≥ 42	57	55	57	57	56
Puncture Resistance (pounds) ASTM D 4833			≥ 90	157	154	155	155	153
Tensile Pr. ASTM D 638	Strength	At Yield, ppi	≥ 126	175	174	181	177	177
		At Break, ppi	≥ 90	164	157	178	164	141
Tensile Properties ASTM D 638	Elongation	At Yield, %	≥ 12	18	18	18	18	18
		At Break, %	≥ 100	378	397	503	450	351
Carbon Dispersion (Category) ASTM D 5596			Cat 1 or 2	1	1	1	1	1
Sheet Density (grams/cc) ASTM D 1505			≥ 0.94	0.947	0.947	0.948	0.948	0.948
NCTL (hrs.) ASTM D 5397			≥ 300	PASS	PASS	PASS	PASS	PASS
Asperity Height (mils) GRI GM 12			≥ 10	20/20	19/19	19/19	24/23	23/22
PROVED				YES	YES	YES	YES	YES

NOTE: All 71 rolls manufactured for the Uwharrie Regional MSW Landfill project meet Thickness (ASTM D5994) and Asperity Height (GRI GM12) requirements. The resin lots passed NCTL testing.

UWHARRIE REGIONAL MSW LANDFILL
MONTGOMERY COUNTY, NORTH CAROLINA
CONSTRUCTION QUALITY ASSURANCE - CQA CELL NO. 12
Bunnett-Lammons Engineering, Inc. Project No. J07-1002-78

Material: 60 mil Textured HDPE Geomembrane
Manufacturer: Poly-Flex, Inc.

CONFORMANCE TEST (2)		REQUIRED TEST VALUE	CONFORMANCE TEST RESULT				
			Roll Number/Resin Batch Number				
			HTI-6-07-7530-5 8271517	HTI-6-07-7550-5 8271517	HTI-6-07-7563-5 8271517	HTI-6-07-7584-5 8271519	HTI-6-07-7591-5 8271519
Thickness (mils) ASTM D 5994	≥ 60	61	61	61	61	61	61
Sheet Density (grams/cc) ASTM D 1505	≥ 0.94	0.9486	0.9481	0.9488	0.9486	0.9493	
Carbon Black Content (%) ASTM D 1603	2 to 3	2.33	2.37	2.36	2.36	2.64	
Tensile Properties ASTM D 638	At Yield, ppi ≥ 126	196/201	200/209	195/192	188/182	180/181	
	At Break, ppi ≥ 90	242/210	245/211	244/195	250/187	224/187	
Tensile Properties ASTM D 638	At Yield, % ≥ 12	17/17	17/16	17/16	17/17	14/14	
	At Break, % ≥ 100	559/481	546/465	544/452	541/432	540/489	
Tear Resistance (lbs) ASTM D 1004	≥ 42	56/59	59/59	58/59	59/60	64/63	
Melt Index (grams/10 minutes) ASTM D 1238	NONE	0.2517	0.2409	0.2310	0.2402	0.2306	
APPROVED		YES	YES	YES	YES	YES	YES

NOTE (1): Test values are machine direction / transverse direction

NOTE (2): All 71 rolls manufactured for the Uwharrie Regional MSW Landfill project meet Thickness (ASTM D5994) requirements.

Roll # 's
HTI-6-07-7522-S
HTI-6-07-7547-S
TRANSFERRED TO EAST CAROLINA

EXPLORATION OF POTENTIAL BORROW AREA - TRIPP PROPERTY
SUMMARY OF POTENTIAL PROTECTIVE COVER SAND ($k \geq 1 \text{ E-03 cm/s}$) & CLAY LINER ($k \leq 1 \text{ E-07 cm/s}$) BORROW TEST DATA

EAST CAROLINA REGIONAL MSW LANDFILL
 BERTIE COUNTY, NORTH CAROLINA
 Bunneil-Lammons Engineering, Inc. Project Number J05-1001-51

SAMPLE NO. / TEST PIT NO.	SAMPLE DEPTH ft.	MATERIAL DESCRIPTION	PERCENT FINES ($< \#200$ sieve) %	ATTERBERG LIMITS		PROCTOR PARAMETERS		HYDRAULIC CONDUCTIVITY (ASTM D 5084) (95% Compaction) ($> 2\%$ over OMC) cm/s	HYDRAULIC CONDUCTIVITY (ASTM D 2434) (Dense) cm/s
				LIQUID LIMIT	PLASTICITY INDEX	MAXIMUM DRY DENSITY pcf	OPTIMUM MOISTURE CONTENT %		
TP - 5	4.0 - 6.5	Gray, silty, fine sandy CLAY (CH)	77.1	55	33	100.1	19.9	4.2 E-08	---
TP - 6	8.0	Gray, silty, fine sandy CLAY (CL)	81.1	46	27	102.9	18.5	5.6 E-08	---
B-1 & B-2	13.5 - 15.5	Yellowish tan and grayish white silty SAND	13.4	---	---	---	---	---	3.2 E-03
B-6	13.5 - 15.5	Yellowish tan silty SAND	8.6	---	---	---	---	---	1.3 E-02
TP - 6	13.5	Yellow and brown silty fine SAND	8.2	---	---	---	---	---	1.7 E-02
TP - 7	14.75 - 17.5	Brown slightly silty, fine SAND with intermittent layers of gray slightly clayey, fine SAND	9.2	---	---	---	---	---	1.2 E-02
TP - 11	10	Brown and gray, slightly silty, fine medium SAND with few clay nodules	10.0	---	---	---	---	---	3.3 E-03